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COMPARING IMPACT BEHAVIOR OF NATURAL FIBER WITH TERMITE MOUND AND EGG SHELL FILLER ADDED REINFORCED COMPOSITE

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ABSTRACT

Natural fibers are biodegradable and eco-friendly materials which are available in vast. At present days researchers focus more on using natural fiber for the fabrication of new materials with different properties and products. The coir fibers are randomly oriented and successfully fabricated by using compression molding process. The investigation activity mainly focused on comparing the impact behavior of vinyl ester based termite mound filler added coir fiber composite and eggshell filler added coir fiber composite. The fabrication of composite test specimens is prepared with the different length of coir from 10mm to 50mm and the particulate weight percent from 10 to 30. The result discussed reveals that the termite mound filler added coir composite has higher impact strength than eggshell filler added coir composite.

***KEYWORDS:** Termite, Coir Fiber, Vinyl Ester Resin & Compression Molding*

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Original Article

INTRODUCTION

Composites

The Composites are materials consist of two or more chemically distinct constituents on a macro scale having a distinct interface separating them and having bulk properties significantly different from those of any of the constituents. The polymer matrix composite contains the Vinyl ester as base material reinforced with the combination of coir fiber and termite mound as one composition and combination of coir fiber and eggshell provides next composition. The termite mound filler provides good bonding with coir fiber and vinyl ester, which in turn improves the mechanical property of polymer matrix composite. With the standard design and fabrication of the PMC, the new composition exhibits good mechanical properties, instead of using them separately. Composites typically have a fiber or particle phase that is stiffer and stronger than the continuous matrix phase and serve as the principal load carrying members. The composite materials are one in which the fibers are reinforced in a matrix (organic or inorganic) which forms the position and orientation. The fiber holds the load carrying capacity embedded inside the matrix. Composite manufactured here is fiber reinforced with a thermosetting/thermoplastic polymer which is known as Fiber Reinforced Composite (FRP). FRP comprises fibers of high strength, lightweight, and high stiffness, entrenched in a matrix with different interfaces between them. The role of the matrix is to convey the weight to the fibers and to afford an obstacle against an adverse environment and to guard the surface of the fibers against mechanical abrasion.

Joshi et al [1] reveals that natural fiber reinforced composites are eco-friendly and its light weight and high strength proves their superiority in specific applications. When these types of composites were used in automobiles will decrease the fuel consumption and emission. Comparisons were made between natural fiber and glass fiber reinforced composites.

Wei. C et al [2] have tested the natural fiber (coir) reinforced composites in the applications of the post box, helmets, etc. and the test report shows the flexural strength of about 38MPa. The weight percentage of fiber added was 9 to 15%. Mukherjee et al [4] results indicated that with varying diameter of the fiber has no effect on strength, but by varying length it shows a diverse change in the strength. The fiber used in this composite was sisal fiber.

Harish et al [5] compared the results of natural fiber reinforced composite with glass fiber reinforced composite and reported that with the addition of filler materials to the composite gives an added advantage for the betterment of the strength of the composite material. They used coir fiber as a natural fiber and made comparisons with the artificial fiber i.e., glass fiber.

S. Harish et al results reveal that the glass fiber reinforced composites has lower flexural, impact and tensile strength when compared to coir fiber reinforced composite. Moreover, the composite produced with natural fiber are environmentally friendly. The natural fiber composite found wide application in the automobile industry and it improves the fuel efficiency and lowers the emission. D. Lingaraju et al produced the composite material with glass woven mat and Nano filler by varying different weight percent and the results shows an increase in the hardness value of the composite.

In the present method, composites were fabricated with coir fiber and the filler materials termite mound and egg shells were used by varying the weight percentage. The prepared composite was tested and the results discussed below.

MATERIALS AND PROCESSING

Materials of Composites:

The materials used for the manufacturing of natural fiber reinforced composite is listed in the table

Table 1: The Materials used for the Manufacturing of Natural Fiber

Material	Type
Matrix	Vinyl ester resin
Catalyst	Methyl Ethyl Ketone Peroxide(MEKP)
Accelerator	Cobalt Octoate
Promotor	Di Methyl Aniline (DMA)
Filler	Termite mound soil and Boiled Egg shell
Reinforcement	Coir fiber
Releasing agent	PVA

Coir Fiber

Coir fiber is extracted from the coconut husk. These coir fibers are used commercially for the production of ropes, bags, mattresses, etc by the traditional method. India and Sri Lanka stood first in the use of Coir fiber for many applications which have been manufactured by the traditional method. The coir fiber extracted was treated chemically and the dry fibers were cut into 10 to 50mm length for the composite material preparation. Coir fiber is available in plentiful quantity and use of it is very less for the production of composite materials. So this research work will lead the world to make of use of coir fiber in the production of composite material (Bio-degradable) which can replace the glass fiber reinforced composite materials (non-degradable). Figure 1 shows the alkali treated coir fiber which has been used in this

research work.

Figure 1: Coir Fiber

Vinyl Ester Resin

A Several reference exhibit that the polymers possess good binding property comparing to other binders. The accessibility together with the lower cost intensifies the selection of polymers as a binder. The properties of mold ability, handling and flow ability are well enhanced by the presence of unsaturated Vinyl ester in the polymer matrix. Vinyl ester resin has a lower viscosity than polyester resin and it is more transparent. It is easy to fabricate composite material by using this resin which added its advantage. The resin will get melted when in contact with gasoline and the hardener used is same as polyester resin and the mixing ratio will be 10:1 (Resin: Hardener). The cost of resin and hardener will be equal to that of polyester resin and hardener, but won't show a huge difference. The mechanical properties of Vinyl ester resin are shown in the Table below.

Table 2: Mechanical Properties of Vinyl Ester Resin

Properties	Values
Density	1320 kg/m^3
Poisson’s Ratio	0.33
Young’s Modulus	3.5 GPa
Thermal Conductivity	0.21 W/m ^{0}C

Composite Fabrication

A stainless steel mold having a size of (300mm× 300mm × 3mm) was used for composite fabrication using compression molding process. The fabrication parameters and their levels are given in Table 3.

Table 3: Parameters and their Level

Model	Fiber Length (mm)	Fiber Content (%)	Particulate Content (%)
S1	10	**30**	**10**
S2	10	20	20
S3	10	10	30
S4	30	30	10
S5	30	20	20
S6	30	10	30
S7	50	30	10
S8	50	20	20
S9	50	10	30

In the fabrication of natural fiber composite, a mold plate was taken and the releasing agent Poly Vinyl Acetate (PVA) was applied first to the surface for removal of the foreign particles and for non-stickiness of the composite material to the surface during removal from mold plate. This PVA helps for easy removal of the composite material from the mold after compression. In this compression molding technique was used to fabricate the composite material. The matrix material composes of unsaturated Vinyl ester resin, termite mound sand which acts as a filler, Cobalt octoate accelerator and the catalyst as Methyl Ethyl Ketone Peroxide (MEKP). These matrix materials are mixed in the ratio 1:0.015:0.015 and coir fiber is pre-impregnated with this matrix. Then this is placed in the resin which has the mold size of 300 mm x 300 mm and all these are compressed heavily in the compression molding machine. After 60 minutes, the composite material is removed from the mold and it is cured at a temperature above room temperature i.e., approximately 28º C for one day. Now, the prepared composite materials taken for several testing's based on the need and shapes were cut according to the ASTM testing standards.

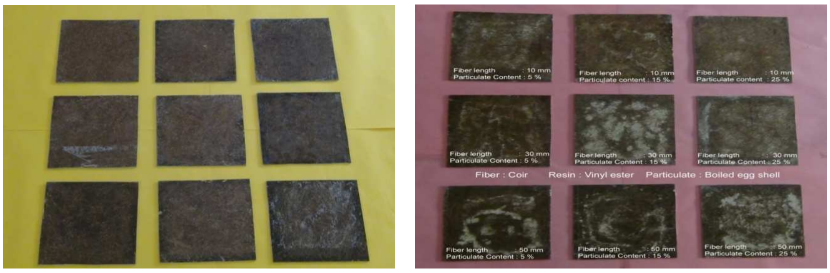

Figure 2: Photographic Images of Fabricated Composite Sheets

EXPERIMENTAL RESULTS AND DISCUSSIONS

Impact Testing

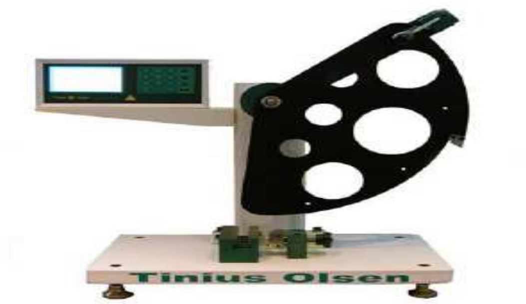

Figure 3: Photographic Image of Impact Tester

Impact test specimen sample prepared as per ASTM standard ASTM D256-05 and the size of the specimen is (64x12.7x3.2). The specimen is tested in Tinius Olsen Impact test machine the impact energy was calculated based on the height to which the striker would have risen, if no test specimen was in place, and this was compared to the height to which the striker actually rose

$$\text{Impact strength}(\text{kJ/m}^2) = \frac{\text{Impact energy(J)}}{\text{Cross sectional area}(\text{m}^2)} \times \frac{1}{10^3} \tag{1}$$

The Izod impact strength was calculated using the Equation (1) and the photographic images testing machine and Tested impact specimens are shown in Figures 4 and respectively

Figure 4: Photographic Image of Fractured Impact Test Specimen

Effect of Fiber Parameters

The Figure 5 shows the relationship between fabrication parameter and impact strength of termite mound filler added composite and eggshell filler added composite. The maximum Impact strength is obtained in all the levels of fiber length tabulated. The maximum Impact strength was obtained in 30 mm fiber length, 20% Particulate content in the termite mound filler added polymer composite exhibit value of 45.35kJ/m^2. In eggshell filler added composite exhibit the maximum impact value 37.3kJ/m^2 in the 50 mm fiber length, 20% Particulate content composite. The very low Impact strength was obtained in 10 mm fiber length, 10% Particulate content in both eggshell filler and termite mound added composite.

Table 4: Parameters and their Level

Runs	Fibre Length (Mm)	Particulate Content %	Impact Strength Kj/Mm^2	Impact Strength Kj/Mm^2
1	10	10	25.65	27.0
2	10	20	38.75	33.5
3	10	30	29.35	29.0
4	30	10	34.65	32.3
5	30	20	45.35	37.1
6	30	30	38.75	31.1
7	50	10	32.45	32.0
8	50	20	40.25	37.3
9	50	30	28.6	30.9

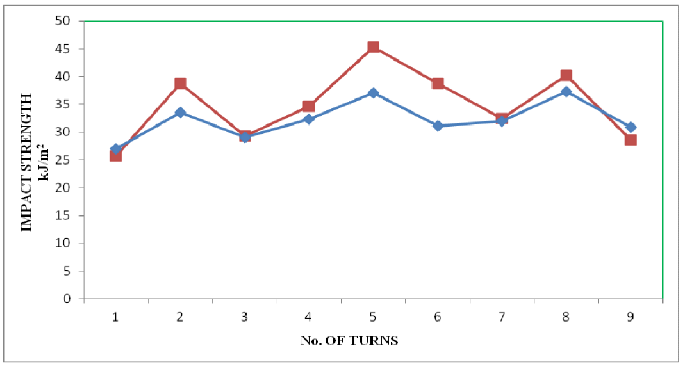

Figure 5: Comparison of Impact Strength of Termite Mound Filler and Egg Shell Filler

CONCLUSIONS

The composite material was prepared using termite mound and eggshell filler material in the composition of 10-30%. The material was bio-degradable waste and found it has good impact strength than other composite material. This investigation activity mainly focused on comparing the impact behavior of vinyl ester based termite mound filler added coir fiber composite and eggshell filler added coir fiber composite. The material prepared with 20% termite mound particulate coir fiber reinforced composite with 30 fiber length has the highest impact strength. It has been discovered that termite mound particulate improves the impact strength and can be able to withstand sudden impact load.

REFERENCES

1. *Asasutjarit, C., Hirunlabh, J., Khedari, J., Charoenvai, S., Zeghmati, B., Cheul Shin, U.,"Development of coconut coir-based lightweight cement board", Construction and Building Materials, February 2007, Volume 21, Issue 2, pp. 277–288.*
2. *Dipa Ray, B. K. Sarkar, A. K. Rana, N. R. Bose, "Effect of alkali treated jute fibres on composite properties", Bulletin of Materials Science, April 2001, Volume 24, Issue 2, pp. 129-135.*
3. *Dixit S. and Verma P, "The Effect of Hybridization on Mechanical Behavior of Coir/Sisal/Jute Fibers Reinforced Polyester Composite Material", Research Journal of Chemical Sciences, www.isca.in, ISSN 2231-606, Vol. 2(6), 91-93, June 2012.*
4. *Harish, S., Peter Michael, D., Bensely, A., Mohan Lal, D. and Rajadurai, A. "Mechanical property evaluation of natural fiber coir composite", Materials Characterization, 2009Vol.60, pp. 44-49.*
5. *B. Dimzoski, G. Bogoeva-Gaceva, G. Gentile, M. Avella and A. Grozdanov, "Polypropylene-based Eco-composites Filled with Agricultural Rice Hulls Waste", Chem. Biochem. Eng. Q. 23 (2), Page No. 225–230, 2009.*
6. *Jochen Gassan, Andrzej K. Bledzki,"The influence of fiber-surface treatment on the mechanical properties of jute-polypropylene composites", Composites Part A: Applied Science and Manufacturing, 1997, Volume 28, Issue 12, pp. 1001–1005.*
7. *Jayabal, S. and Natarajan, U. "Regression & neuro fuzzy models for prediction of thrust force and torque in drilling of glass fibre reinforced composites", Journal of scientific & Industrial Research, Vol. 69, October 2010, pp. 741-745.*
8. *Latha, B. and Senthilkumar, V. S."Fuzzy rule based modeling of drilling parameters for delamination in drilling GFRP composites," Journal of Reinforced Plastics and Composites, 2009, Vol.28, pp.951-964.*
9. *Latha, B. and Senthilkumar, V. S. "Analysis of Thrust Force in Drilling Glass Fiber-Reinforced Plastic Composites Using Fuzzy Logic", Materials and Manufacturing Processes, 2009, Vol.24, pp.509 -516,*
10. *Sankh, Akshay C., et al. "Recent trends in replacement of natural sand with different alternatives." Proceedings of the International Conference on Advances in Engineering and Technology. 2014.*
11. *Monteiro SN, Terrones LAH, D'Almeida JRM. Mechanical performance of coir fiber/polyester composites. Polymer Testing 2008; vol.27.pp.591– 595.*
12. *Monteiro, S. N., Rodriquez, R. J. S., De Souza, M. V., J. R. M. D'Almeida, "Sugar Cane Bagasse Waste as Reinforcement in Low CostComposites", Advanced Performance Materials, December 1998, Volume 5, Issue 3, pp. 183-191.*
13. *Mukherjee, P. S., Satyanarayana KG. Structure and properties of Some Vegetable fiber coir. Material Characterization.1984, vol.60: pp.3925-3934*

14. *Prosenjit Saha, Suvendu Manna, Sougata Roy Chowdhury, Ramkrishna Sen, Debasis Roy, Basudam Adhikari "Enhancement of tensile strength of lignocellulosic jute fibers by alkali-steam treatment", May 2010, Volume 101, Issue 9, Pages 3182–318.*

15. *Paul Wambua. Natural Fibres: can they replace glass in fibre reinforced plastics, Elsevier Science Ltd, Inc., New York 2003: vol.63*

16. *Pramendra kumar Bajpal. Drilling behavior of sisal fiber-reinforced polypropylene composite laminates, J. Reinf. Plast. Compos.(2013), vol.22, pp.1083.*

17. *Rana, A. K., A. Mandal, A., Mitra, B. C., Jacobson, R., Rowell, R., A. N. Banerjee, A. N.,"Short Jute Fiber-Reinforced Polypropylene Composites: Effect of Compatibilizer" Journal of Applied Polymer Science, (1998). Vol. 69, 329-338.*

18. *D. Lingaraju, P. Murali Krishna "Studies on Hardness of Rice Husk Ash Polymer Hybrid Nanocomposites by Burnishing Process". International journal of Advanced Scientific and Technical Research,, ISSN 2249-9954, Vol 2, Issue 1, December 2011.*

19. *Shah, A. N., Lakkad, S. C., "Mechanical properties of jute-reinforced plastics", Fibre Science and Technology, July 1981, Volume 15, Issue 1, pp. 41–46.*

20. *Satyanarayana KG, AG. Pillai. Structure Property studies of fibers from various parts of the coconut tree. Composites,1986, vol.17, pp.329.*

21. *Yan Li, Chunjing Hu, Yehong Yu, "Interfacial studies of sisal fiber reinforced high density polyethylene (HDPE) composites", Composites Part A: Applied Science and Manufacturing, April 2008, Volume 39, Issue 4, pp. 570–578.*